ENGINEERING CHANGE NOTICE

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1. ECN 640360

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [X] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	J. G. Field, LMHC, R2-12 376-3753	[] Yes [X] No	8-14-97
	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
	Tank 241-B-204	NA	NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.)	10. Related ECN No(s).	11. Related PO No.
	WHC-SD-WM-ER-581, Rev. 0	NA	NA

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	NA	NA Design Authority/Cog. Engineer Signature & Date	NA Design Authority/Cog. Engineer Signature & Date

13a. Description of Change | 13b. Design Baseline Document? [] Yes [X] No

Add Appendix E, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-B-204.

14a. Justification (mark one)

Criteria Change	[]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[X]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-B-204 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

15. Distribution (include name, MSIN, and no. of copies)

Central Files	A3-88	K. M. Hall	R2-12
DOE Reading Room	H2-53	K. M. Hodgson	R2-11
TCSRC	R1-10	R. T. Winward	H5-49
File	H5-49	L. M. Sasaki	R2-12
J. G. Field	R2-12		
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

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1. ECN (use no. from pg. 1)
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16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
NA		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng.	M. J. Kupfer M J Kupfer	8-18-97	PE		
Cog. Mgr.	K. M. Hodgson K. M. Hodgson	8-18-97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other	L. M. Sasaki RDAchul for LMS	8/18/97	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-B-204

J. G. Field, K. M. Hodgson, and R. T. Winward (Meier Associates)
Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

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Abstract: An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-B-204 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

Janis Bishop 8-20-97
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RECORD OF REVISION	(1) Document Number WHC-SD-WM-ER-581	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-B-204

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 07/22/96 on EDT 617501.	L. M. Sasaki	J. G. Kristofzski
0A RS	Incorporate per ECN-640360.	M. J. Kupfer	K. M. Hodgson
		M J Kupfer 8-18-97	K. M. Hodgson 8-18-97

APPENDIX E

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-B-204

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APPENDIX E

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-B-204

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for single-shell tank 241-B-204 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

E1.0 CHEMICAL INFORMATION SOURCES

The information provided in the Section 4.0 and Appendix B of this Tank Characterization Report (TCR) includes characterization results from the most recent sampling event for this tank. Two core samples were obtained and analyzed. The Hanford Defined Waste (HDW) model (Agnew et al. 1997a) provides tank content estimates derived from process flowsheets and waste volume records.

E2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Sample-based inventories listed in Table E2-1 were calculated by multiplying the mean concentration of an analyte by the current tank volume and by the mean density of the waste. (The chemical species are reported without charge designation per the best-basis inventory convention). The tank is reported to contain 185 kL (49 kgal) sludge (Hanlon 1997), and the mean density is reported to be 1.19 g/mL.

The HDW model (Agnew et al. 1997a) inventory also is derived using this same waste volume and is also given in Table E2-1. The HDW model uses a sludge volume of 185 kL (49 kgal) of sludge, 3.8 kL (1 kgal) of supernatant, and a sludge density of 1.20 g/mL.

Table E2-1. Sample- and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components for Tank 241-B-204.

Analyte	Sampling[a] inv. estimate (kgs)	HDW[b] inv. estimate (kgs)	Analyte	Sampling[a] inv. estimate (kgs)	HDW[b] inv. estimate (kgs)
Al	14.4	0	Ni	51.5	15.8
Bi	10,700	2,150	NO_2	160	30.9
Ca	67.2	1,820	NO_3	11,800	14,100
Ce	12.3	NR	OH	NR	3,480
Cl	155	156	oxalate	376	17,300
Cr	715	59.7	P as PO_4	1,580	1,480
Cu	4.88	NR	Si	236	0
F	1,580	3,560	SO_4	146	48.8
Fe	839	3,760	Sr	86.1	0
K	1,290	1,490	TIC as CO_3	NR	2,720
La	2,290	87.1	Zn	11.8	NR
Mg	18.3	NR	H_2O (wt%)	77.1	69.1
Mn	3,270	46.2	density (g/mL)	1.19	1.20
Na	5,880	18,100			

HDW = Hanford Defined Waste
NR = Not reported
[a] Table 4-2 of this Tank Characterization Report
[b] Agnew et al. (1997a).

E3.0 COMPONENT INVENTORY EVALUATION

The following evaluation provides a best-basis inventory estimate for chemical and radionuclide components in Tank 241-B-204.

E3.1 CONTRIBUTING WASTE TYPES

The following abbreviations were used to designate waste types:

224 = LaF_3 final plutonium decontamination and concentration waste from the $BiPO_4$ process
1C = First decontamination cycle $BiPO_4$ waste, operational 1944 to 1956.

Agnew et al. (1997b) first shows waste in the 200 series tanks in 1952 for B and T Tank Farms and in 1956 for U farm. However, Borsheim (1994) reports that originally the 224 wastes were routed to the 6.1 m (20 ft) diameter concrete settling tank (241-361) and overflowed from there to a dry well. The dry well was replaced by a crib by June 1945.

Cell drainage (5-6 waste) was also routed to the 241-361 tank. High activity cell drainage was supposed to be routed to tanks 241-B-107 and 241-T-107 in the 1C waste cascades. Borsheim (1994) also notes that each of the B and T Tank Farm 200 series tanks were provided with two inlet lines, were not cascaded, and had no overflow lines. Experiments (as of November 1944) indicated that the 224 wastes should contain 3 percent solids by volume.

Borsheim (1994) notes that the "Hanford Works Monthly Reports" show that it was planned to provide a separate crib for the B Plant cell drainage. The cell drainage was then disposed to tank 241-B-201 along with the 224 waste. Tanks 241-B-201 and 241-T-201 were in service as sludge settling tanks for 224-B and T wastes, respectively. The remaining B and T Tank Farm 200 series tanks (202, 203, 204) were being excavated and piped in series to increase settling capacity.

Borsheim (1994) reports that by July 1950, tank 241-B-204, which had been in service since November 1948 was filled to a depth of 6.1 m (20 ft) with sludge. The tank overflowed to tank 241-B-203 tank which had received 10.2 cm (4 in.) of sludge by that time. This suggests that tanks 241-B-201 and 241-T-201 received 224 waste before the other B-200 and T-200 series tanks, and that when the other B-200 series tanks received waste it overflowed from tanks 241-B-204 to 241-B-203 and then to 241-B-202. The T-200 series tanks received 224 waste in a similar fashion.

The waste volumes in tanks 241-B-204, 241-B-203, and 241-B-202 are 189 kL (50 kgal), 193 kL (51 kgal) and 102 kL (27 kgal), respectively (Hanlon 1997). Tank

241-B-201 contains 110 kL (29 kgal) and is piped separately from the other B-200 tanks, indicating that it received waste independent of the other three B-200 series tanks. The T-200 series tank waste volumes show the same trends.

Expected Types of Solids in the Waste
Agnew et al. (1997a): 224

E3.2 EVALUATION OF FLOWSHEET INFORMATION

Technical flowsheet information (Kupfer et al. 1997) for 224 streams is shown in Table E3-1. The comparative HDW waste streams are also shown in this Table E3-1.

Table E3-1. Technical Flowsheet and Hanford Defined Waste Defined Waste Streams for 224 Waste.

Analyte	Flowsheet 224[a] (M)	Flowsheet 224[a] (M)	HDW 224[b] (M)
Bi	0.00595	0.00565	0.006
C_2O_4	0.0458	0.0147	0.040
Cr	0.00362	0.00327	0.0068
F	0.272	0.295	0.27
K	0.223	0.218	0.231
La	0.00376	0.00353	0.0038
Mn	0.00514	0.00601	0.0051
Na	1.62	1.60	1.60
NO_3	1.06	0.684	1.38
PO_4	0.0322	0.0321	0.038
SO_4	0.00140	0.00364	0.003
NH_4	NR	0.0067	NR

HDW = Hanford Defined Waste
NR = Not reported
[a] Appendix C of Kupfer et al. (1997), Bismuth Phosphate Process Flowsheet
[b] Agnew et al. (1997a).

E3.3 ASSUMPTIONS FOR RECONCILING WASTE INVENTORIES

Reference inventories of certain components in tank 241-B-204 were estimated using an engineering assessment that is based on a set of simplified assumptions. The inventories were then compared with the tank 241-B-204 sample-based inventories and the HDW model inventories. The assumptions and observations for the engineering assessment were based on best technical judgement pertaining to input information that can significantly influence tank inventories. This includes: (1) correct prediction of contributing waste types, and correct relative proportions of the waste types, (2) accurate predictions of flowsheet conditions, fuel processed, and waste volumes, (3) accurate prediction of partitioning of components, and (4) accurate predictions of physical parameters such as density, percent solids, etc. By using this evaluation, the assumptions can be modified as necessary to provide a basis for identifying potential errors and/or missing information that could influence the sample- and model-based inventories. The following are simplified assumptions and observations used for the evaluation.

- Tank waste mass is calculated using a measured density of 1.19 kg/L and a tank volume of 189 kL (50 kgal). Both analytical-based and model-based inventories are derived using this volume. There is a slight difference in the density value used for the analytical-based and model-based inventories (1.9 kg/L versus 1.20 kg/L). However, the inventory comparisons are made on essentially the same volume basis.

- Only the 224 waste stream contributed to solids formation. It is assumed that tanks with the same waste type will have the same concentrations of individual analytes.

- Bulk component (chemical species) information is sufficient for comparing analytical and computed data sets. This information can be obtained from technical flowsheets (see Table E3-1).

- No radiolysis of NO_3 to NO_2 and no additions of NO_2 to the waste for corrosion control purposes are factored into this evaluation.

- All Bi and Mn precipitate.

- No Si from blowsand is factored into this evaluation.

- All NO_3, C_2O_4, K, and Na remain dissolved in the interstitial liquid.

- Only the 224 waste stream contributes to the interstitial liquid.

- Concentration of components in interstitial liquid is based on a porosity of 0.834 as reported by Agnew et al. (1997a).

- La, Cr, PO_4, SO_4, and F partition between the liquid and solid phases.

E3.4 BASIS FOR CALCULATIONS USED IN THIS ENGINEERING EVALUATION

Because analytical data from a recent sampling event exists for tank 241-B-204, a throughput or concentration factor was derived. For those analytes that partially precipitated, a partitioning factor (PF) was also calculated.

E3.4.1 THROUGHPUT OR CONCENTRATION FACTOR

The concentration factor (CF) was derived using a flowsheet component that is assumed to be 100 percent insoluble and 100 percent contained in the tank. The CF was determined by dividing the inventory found in the sample analysis by the inventory in the original waste stream (from the flowsheet). The CF factor was calculated as follows:

CF = sample inventory (kg) ÷ flowsheet inventory (kg)

This CF factor was used to calculate inventories for all analytes that precipitate in the tank. If the CF factor is valid and the assumptions regarding the process history of the waste, the flowsheet and the analytical data are correct; then inventories predicted by this investigation should be close to those reported in the analytical data, and tanks with the same waste type should have the same CF. Concentration factors for the B-200 series tanks are presented in Table E3-2.

Table E3-2. Concentration Factors for 224 Waste in Tanks 241-B-201, 241-B-202, 241-B-203, and 241-B-204. (2 Sheets)

Analyte	Tank 241-B-201[a]	Tank 241-B-202[b]	Tank 241-B-203[c]	Tank 241-B-204[d]
Bi	95	31	39	45
Cr	22	15	19	20
F	0.35	1.45	1.80	1.62
K	0.83	0.91	0.71	0.78
La	36	30	23	23
Mn	85	56	58	61
Na	1.28	1.19	0.93	0.83
NO_3	0.94	1.15	1.15	0.95

Table E3-2. Concentration Factors for 224 Waste in Tanks 241-B-201, 241-B-202, 241-B-203, and 241-B-204. (2 Sheets)

Analyte	Tank 241-B-201[a]	Tank 241-B-202[b]	Tank 241-B-203[c]	Tank 241-B-204[d]
PO_4	6.83	3.50	1.48	2.72
SO_4	3.24	12.57	6.17	5.74

[a] Based on data from Conner et al. (1997)
[b] Based on data from Pool (1994)
[c] Based on data from Jo et al. (1996)
[d] Based on data from Section 4.0 of this Tank Characterization Report.

The concentration factors indicate that the three tanks (241-B-204, 241-B-203, and 241-B-202) that were part of a cascade are similar, but the tank (241-B-201) that was filled separately is different for several analytes.

E3.4.2 PARTITIONING FACTOR

Once CFs for fully precipitated components for a waste type are determined, the CF factor can be used to assess how components such as SO_4 or PO_4 partition between solids and supernatant. For example, if the CF for bismuth is determined to be 45 for 224 waste, and the CF for PO_4 is 2.72, then the PF between PO_4 and bismuth is 0.06 (2.75 ÷ 45). This indicates that 6 percent of the PO_4 in the neutralized process waste is associated with the waste solids.

Using this method, the PF for several components for 224 waste for each tank in the B 200 series were calculated (Table E3-3). The CF for bismuth was used for the fully precipitated components.

Table E3-3. Partition Factors For The 224 Waste In The B-200 Series Tanks. (2 Sheets)

Analyte	Tank 241-B-201[a]	Tank 241-B-202[b]	Tank 241-B-203[c]	Tank 241-B-204[d]
Bi	1	1	1	1
Cr	0.23	0.49	0.49	0.44
F	0.0037	0.046	0.046	0.036
K	0.0087	0.029	0.018	0.017
La	0.38	0.96	0.60	0.51
Mn	0.89	1.77	1.49	1.35
Na	0.013	0.038	0.024	0.018
NO_3	0.0099	0.037	0.029	0.021

Table E3-3. Partition Factors For The 224 Waste In The B-200 Series Tanks. (2 Sheets)

Analyte	Tank 241-B-201[a]	Tank 241-B-202[b]	Tank 241-B-203[c]	Tank 241-B-204[d]
PO_4	0.072	0.11	0.038	0.060
SO_4	0.034	0.40	0.16	0.13

[a] Based on Data From Conner et al. (1997)
[b] Based on Data From Pool (1994)
[c] Based on Data From Jo et al. (1996)
[d] Based on Data From Section 4.0 of this Tank Characterization Report.

E3.4.3 SAMPLE CALCULATIONS USED IN THIS ENGINEERING EVALUATION

Flowsheet inventories for components assumed to precipitate (e.g., Bi and Mn) and components assumed to remain dissolved in the interstitial liquid (e.g., NO_3, K, and Na) were calculated as follows.

Components Assumed to Precipitate (Bi, Mn)

$$kg_{analyte} = Moles_{analyte}/L_{224} \times 189{,}000 \text{ L} \times g/mole_{analyte} \times CF_{analyte} \times kg/1{,}000 \text{ g}$$

Components Assumed to remain dissolved in the interstitial liquid (NO_3, K, Na)

$$kg_{analyte} = Moles_{analyte}/L_{224} \times 0.834_{porosity} \times 189{,}000 \text{ L} \times g/mole_{analyte} \times kg/1{,}000 \text{ g}$$

Estimated component inventories from the flowsheet evaluation are compared with sample- and HDW model-based inventories for selected components in Table E3-4. Observations regarding these inventories are noted by component in the following text.

Bismuth. This evaluation assumed Bi to precipitate 100 percent. Bismuth was used to determine the CF for this waste tank. This was accomplished by determining what CF would be necessary to bring the waste stream concentration, times the total waste volume, into agreement with the sampling data. This biases the data to match the sampling results for this one analyte. However, when this CF is used for the other analytes, and the results agree with the sampling data (for example, manganese). This degree of agreement suggests that the CF is near the true CF for this tank. The HDW (Agnew et al. 1997a) estimate is about five times lower than the sample based CF. This appears to be caused by the assumption in the HDW model that bismuth is partially soluble.

Table E3-4. Comparison of Selected Component Inventory Estimates for Tank 241-B-204.

Component	Flowsheet evaluation (kg)	Sample-based (kg)[a]	HDW estimate (kg)[b]
Bi	10,600	10,700	2,150
K	1,380	1,290	1,490
La	NE	2,290	87.1
NO_3	10,400	11,800	14,100
Mn	3,250	3,270	46.2
SO_4	NE	146	48.8
Cr	NE	715	59.7
PO_4	NE	1,580	1,480
F	NE	1,580	3,560
Na	5,880	5,880	18,100
H_2O %	NE	77.1	69.1

HDW = Hanford Defined Waste
NE = Not estimated
[a] Table 4-2 of this Tank Characterization Report
[b] Agnew et al. (1997a).

Nitrate. The HDW estimated inventory is larger than the sample-based inventory and the inventory estimated in this evaluation is nearly the same as the sample-based inventory. The results of the flowsheet evaluation differ from the sampling analytical results by about 12 percent. The HDW estimate is about 23 percent higher than the analytical results, which is in reasonable agreement. The HDW estimated inventory derived from the LANL-defined 224 waste stream is about 30 percent higher than the flowsheet inventory (Appendix C of Kupfer et al. 1997).

Sulfate. The HDW estimated inventory is smaller than the sample-based inventory. However, SO_4 does not appear to be a principal process chemical in the LaF_3 finishing step. The "Schneider" flowsheet waste stream estimate is about three times higher for sulfate than the "Place" flowsheet estimate (Appendix C of Kupfer et al. 1997). If the "Schneider" value is used in the HDW model, then the HDW would probably more closely agree with the sample analytical data. Because almost everything else agrees with the sample-based inventory, further evaluation should be made between the sulfate concentrations predicted in the "Place" and "Schneider" flowsheets.

Chromium. The HDW-estimated inventory is considerably lower than the sample-based inventory. The data suggests that about 46 percent of the Cr precipitated; the HDW model assumes a much smaller percent. However, Cr does not appear to be a principal process chemical.

Phosphate. The sample-based phosphate value is close to the HDW value. However, the HDW (Agnew et al. 1997a) defined waste concentration for phosphate is three times the Place (Kupfer et al. 1997) value indicating that the model may not correctly represent the solubility of this compound or the total of this waste added to tank 241-B-204.

Fluoride. The analytical sample evaluation is based on water soluble fluoride only. The sample value is about 2.3 times lower than the HDW value. Until a sample is analyzed by a methodology that measures total fluoride, these differences cannot be reconciled.

Sodium. The sodium values calculated assumed Na does not partition and slightly under-predicts the sample analysis values. The HDW value is approximately three times the value from this evaluation. The difference between the flowsheet values used here and the HDW value also is approximately a factor of three.

Potassium. The HDW model and sampling values for potassium agree fairly well.

Lanthanum. Lanthanum appears to partition between the phases in the tank. The PF for La was 0.51, indicating that an equal amount of La remaining in the tanks could have been released to the cribs.

Manganese. This is an insoluble analyte, and the value from this evaluation is in good agreement with the sample analytical data. However, the HDW model treats manganese as highly soluble and thus predicts about 71 times less manganese in the waste.

Total Hydroxide. Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. In some cases this approach requires that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments the number of significant figures is not increased. This charge balance approach was consistent with that used by Agnew et al. (1997a). The calculated total hydroxide inventories based on engineering assessments and HDW model estimates were 4,320 kg and 3,480 kg, respectively.

Comments On Other Analytes

Strontium. The HDW model estimate for Sr is about 300 times higher than sampling results. The HDW model shows Sr in the 224 defined waste stream, apparently added for scavenging ^{90}Sr. This is incorrect; scavenging should be shown in the ferrocyanide defined wastes.

E3.5 CONCLUSIONS

The calculations based on the flowsheet information and factors determined from the bismuth analytical data from tank 241-B-204 have been compared to analytical data and the

HDW model. These calculations compare well with the analytical data and, in some cases, with the HDW model. It appears that the flowsheet concentrations and the solubility assumptions applied in the HDW model account for the major differences.

The calculated CFs and PFs for tank 241-B-204 provide confidence that the analytical data for the tanks are representative of the tank contents and could be used as a basis for component inventories. This is substantiated by the following:

- Concentration Factors for components in tank 241-B-204 that are expected to fully precipitate are consistent indicating the sample probably represents the 224 flowsheet basis for the waste.

- The PFs indicate reasonable partitioning of components based on experience and knowledge of the typical chemical behavior of the components in alkaline media.

- The flowsheet data and HDW model estimate do not indicate any reason to refute the analytical findings.

E4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities and to address regulatory issues. These activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities include designing equipment, processes, and facilities for retrieving wastes, and processing them into a form suitable for long-term storage/disposal.

Chemical and radiological inventory information are generally derived using three approaches: (1) component inventories are estimated using the results of sample analyses or data from similar tanks, (2) component inventories are predicted using the HDW model based on process knowledge and historical information, or (3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage, and other operating data. The information derived from these different approaches is often inconsistent.

As part of this effort, an evaluation of available chemical information for tank 241-B-204 was performed, including the following:

- Data from two 1995 core samples (this TCR).
- An inventory estimate generated by the HDW model (Agnew et al. 1997a).
- Estimating CFs for analytes in tanks 241-B-201, 241-B-202 and 241-B-203.

The calculations based on flowsheet information and factors determined from the bismuth analytical data from tank 241-B-204 were compared with analytical data and the HDW model. The flowsheet calculations compared well with the analytical data and, in some cases, with the HDW model.

The best source of inventory data appeared to be the analytical data that was obtained during the 1995 core sampling and analysis event. One analyte, for which the analytical data is suspect, is fluoride. Only the water soluble forms of fluoride are reported in the analytical data, because water insoluble fluoride was not measured. Tables E4-1 and E4-2 present the best-basis inventory estimates for the nonradioactive and radioactive waste components, respectively. The inventory values reported in Tables E4-1 and E4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}Pu$, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the HDW Rev. 4 model results (Agnew et al. 1997a). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10. The radionuclide inventories shown in Table E4-1 are based on engineering assessments and Agnew et al. (1997a) HDW model estimates for tank 241-B-204.

Table E4-1. Sample-Based Inventory Estimates for Nonradioactive Components in Tank 241-B-204 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C, or E)[1]	Comment
Al	14.4	S	
Bi	10,700	S	
Ca	67.2	S	
Cl	155	S	
TIC as CO_3	2,720	M	
Cr	715	S	
F	1,580	S	Only the water soluble forms of fluoride are reported in the analytical data.
Fe	839	S	
Hg	0	M	
K	1,290	S	
La	2,290	S	
Mn	3,270	S	
Na	5,880	S	
Ni	51.5	S	
NO_2	160	S	
NO_3	11,800	S	
OH_{TOTAL}	4,320	C	Calculated from change balance
Pb	0	M	

Table E4-1. Sample-Based Inventory Estimates for Nonradioactive Components in Tank 241-B-204 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C, or E)[1]	Comment
P as PO_4	1,580	S	
Si	236	S	
SO_4	146	S	
Sr	86.1	S	
TOC	4,720	M	
U_{TOTAL}	14.2	M	
Zr	0	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997a)
E = Engineering assessment-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3

Table E4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-204, Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	9.86 E-04	M	
^{14}C	3.05 E-04	M	
^{59}Ni	8.68 E-05	M	
^{60}Co	9.81 E-05	M	
^{63}Ni	0.00801	M	
^{79}Se	6.44 E-05	M	
^{90}Sr	31.9	M	
^{90}Y	31.9	M	
^{93m}Nb	2.53 E-04	M	
^{93}Zr	3.06 E-04	M	
^{99}Tc	0.00212	M	
^{106}Ru	7.35 E-11	M	
^{113m}Cd	8.56 E-04	M	
^{125}Sb	1.13 E-04	M	
^{126}Sn	9.72 E-05	M	
^{129}I	4.00 E-06	M	
^{134}Cs	4.87 E-06	M	
^{137m}Ba	34.2	M	
^{137}Cs	36.2	M	
^{151}Sm	0.244	M	
^{152}Eu	3.19 E-04	M	
^{154}Eu	0.00157	M	
^{155}Eu	0.0288	M	
^{226}Ra	1.44 E-08	M	
^{227}Ac	7.59 E-08	M	
^{228}Ra	9.25 E-13	M	
^{229}Th	1.79 E-10	M	
^{231}Pa	1.75 E-07	M	
^{232}Th	8.08 E-14	M	
^{232}U	9.38 E-08	M	

Table E4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-204, Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{233}U	4.28 E-09	M	
^{234}U	0.00468	M	
^{235}U	2.08 E-04	M	
^{236}U	4.08 E-05	M	
^{237}Np	1.31 E-05	M	
^{238}Pu	5.61 E-04	M	
^{238}U	0.00475	M	
^{239}Pu	0.081	M	
^{240}Pu	0.0071	M	
^{241}Am	6.64 E-04	M	
^{241}Pu	0.0236	M	
^{242}Cm	6.48 E-06	M	
^{242}Pu	1.09 E-07	M	
^{243}Am	5.40 E-09	M	
^{243}Cm	1.40 E-07	M	
^{244}Cm	1.37 E-07	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997a)
E = Engineering assessment-based

E5.0 APPENDIX E REFERENCES

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